REMARKS

In response to the Office Action mailed August 26, 2003 and the Advisory Action mailed November 28, 2003, Applicants amend their application and request reconsideration. No claims are added or cancelled so that claims 1-16 remain pending.

Claim 1 is the sole pending independent claim. Although there was a rejection as to form with respect to all claims, based upon claim 1, if claim 1 is patentable, then so are claims 2-16. Thus, the following discussion focuses on claim 1.

Although not set out at length here, Applicants maintain the positions advanced in the prior response, even if not repeated. The prior Remarks are incorporated by reference.

Amendment of Claims

In this Amendment, claim 1 is amended to specify that the semiconductor laser device includes opposed power supply electrodes sandwiching the phase-shifting structure. This amendment is clearly supported by the application bas filed, for example, by the description of the first embodiment at page 10, lines 1-3 of the patent application. The claim is also amended to state that the diffraction grating layer must be present, i.e., has a length greater than zero. This description is supported in the patent application, for example, at page 9, lines 12-22.

Rejection Pursuant to 35 USC 112

All claims were rejected pursuant to 35 USC 112, second paragraph as indefinite. This rejection was clarified in the Advisory Action. It is understood the Examiner modified his view that claim 1 expressed both a broad range and an embedded narrower range, leading to confusion as to the limits of the claim. As understood, the view is now maintained solely because claim 1 permits the diffraction grating layer length, L, to be zero.

Applicants disagree with the Examiner that the diffraction grating layer can have a zero length. The diffraction grating layer is an essential, positively claimed element of the semiconductor laser device of claim 1. If that diffraction grating layer had a length of zero, i.e., did not exist, then the device would not fall within the scope of claim 1. Moreover, to avoid further attention to this tangential issue, claim 1 has been amended to describe the diffraction grating layer as having a length greater than zero.

For these reasons, the rejection of claims 1-16 as indefinite, upon reconsideration, should be withdrawn.

The Prior Art Rejection

As clarified in the Advisory Action, the examined claims were all rejected as obvious over Takahashi (U.S. Patent 5,960,023) in view of Nakajima et al. (U.S. Patent 5,412,496, hereinafter Nakajima). This rejection is respectfully traversed.

The description of the semiconductor laser disclosed by Takahashi that appears in the Official Action of August 26, 2003 beginning in the final line of page 3 and continuing through page 4, line 11 is not questioned. Like the semiconductor laser according to the invention, the laser described by Takahashi includes a diffraction grating having a phase-shifting structure. That semiconductor laser does not include a multiple quantum well structure as the active layer nor any of the quantitative limitations that appear in amended claim 1.

Applicants agree that Nakajima describes a complex semiconductor laser and light detecting structure that includes an active layer with a multiple quantum well structure and having a product κL of approximately 4. However, as shown by the graph presented at page 3, the requirement that κL is approximately equal to 4 does not establish that the laser of Takahashi, if modifiable by the cited parts of Nakajima, would fall within the scope of claim 1. Thus, the modification of Takahashi with Nakajima, as hypothesized in the rejection, does not establish *prima facie* obviousness as to any claim. The hypothetical semiconductor laser constructed from the two patents has not been shown to meet the limitations of any pending claim.

In order to support the argument that the hypothetical combination would fall within the scope of claim 1, the Examiner relied upon the assertion that the invention merely involves the selection of desired properties of the hypothetical laser produced by modifying Takahashi with Nakajima. Applicants respectfully disagree for several reasons.

As previously asserted, the only quantitative information in the two patents, and not already mentioned, is that Takahashi describes laser chips that are square and have an edge length of 250μm and a κL product of 35cm^{-1}. It is apparent that the length of the diffraction grating in these laser chips must be less than 260μm, and thereby within one of the quantitative limitations of claim 1. However, the product κL of these lasers is so far outside the scope of claim 1 that one of skill in the art would find no teaching in Takahashi, even as modified with Nakajima's κL product of approximately 4, that would direct one toward the claimed invention. This fact was proven by the graph supplied at page 3 of the prior response, demonstrating that *prima facie* obviousness of claim 1 cannot be properly asserted based upon the limited quantitative data disclosed in Takahashi and Nakajima.

Subsequent analysis and understanding of the mechanism of the operation of the semiconductor laser described and claimed in the present patent application validates the absence of motivation for modifying the laser structure of Takahashi with the complex structure of the Nakajima device.

Attached to the previous response was a post-invention publication by some of the inventors. That publication, titled "Uncooled 10Gb/s Directly Modulated DFB Laser", shows that in a distributed feedback (DFB) laser diode having a one-quarter wavelength phase-shifting structure, there is a minimum relaxation oscillation frequency for each particular cavity length. As the cavity becomes shorter, meaning a smaller volume within the semiconductor laser, the minimum relaxation oscillation frequency becomes higher. Conversely, a longer cavity length means a higher minimum relaxation oscillation frequency due to a reduction in radiation losses. Thus, as described in the publication and as shown in its Figure 1, the relaxation oscillation frequency of such a semiconductor laser structure is not determined solely by κL, the product of the mean coupling factor and the length of the diffraction grating layer. Rather, referring to Figure 1 of that publication, for a constant coupling factor, κ, relaxation oscillation frequency has a minimum value at a particular cavity length. For decreasing coupling factors, the length of the cavity at which the relaxation oscillation frequency is a minimum, decreases. Stated another way, the relaxation oscillation frequency, if established at a minimum value for a particular cavity length, i.e., diffraction grating layer length, and coupling coefficient, will increase as the cavity length is changed or as the coupling coefficient changes.

Applying the foregoing, post-invention knowledge of the inventors, it is apparent that one of skill in the art would not achieve the invention simply by modifying Takahashi with Nakajima. In Takahashi, the semiconductor laser includes power supply electrodes 112, and 113 that directly oppose each other and have the phase-shifting structure interposed between them. Nakajima does not describe a similar structure but rather includes a tapping, central electrode 30 directly opposite the phase-shifting structure. According to Nakajima, the central electrode 30 detects modulation of a received light signal. In that structure, the optical power within the semiconductor structure tends to be concentrated centrally, i.e., opposite that electrode 30. See column 3, lines 37-39 and Figure 2 of Nakajima. For that reason, in the Nakajima structure, current is not supplied to the central part of the structure where the optical power is concentrated.

By contrast, in the invention, the minimum relaxation oscillation frequency of the semiconductor laser is high, meaning high frequency performance. That performance is achieved by overlapping, within the same region, the highest concentrations of optical power

and current density. Nakajima cannot achieve that result because of the absence of a power supply electrode directly opposite the region of highest optical power concentration. While Takahashi discloses a laser including power electrode supply electrodes that sandwich a phase-shifting structure, a person of skill in the art seeking to produce a semiconductor laser suitable for extremely high speed operation would not find a suggestion in Nakajima for modifying Takahashi to produce that result.

In other words, although Takahashi discloses a semiconductor laser having a diffraction grating length within the limitation of claim 1 and Nakajima describes a semiconductor laser having a product of coupling coefficient and cavity length within the range specified in claim 1, those facts are not sufficient to suggest the claimed invention. The suggestion, i.e., motivation, for the combination hypothesized in the rejection is not present, because neither source of prior art provides a teaching, as in the knowledge disclosed by the inventors in the post-invention publication, of the relationship between minimum relaxation oscillation frequency and each of coupling coefficient and cavity length. Absent that knowledge, not available to a person of ordinary skill in the art at the time of the filing of the present patent application, there would be no motivation to modify Takahashi with Nakajima to produce the claimed invention.

The Advisory Action indicates that the assertion based upon *In re Aller*, 105 USPQ 233, 235 (CCPA 1955) has been withdrawn so that there is no further response to that point..

For all of the foregoing reasons, considered independently of each other, upon reconsideration, pending claims 1-16 should be allowed.

Respectfully submitted,

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